

PUBLIC EDUCATION EXPENDITURE AND DEFENCE SPENDING IN NIGERIA

AN EMPIRICAL INVESTIGATION

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T HIS study, seeks to empirically investigate the empirical relationship between the public education expenditure and the defence spending in Nigeria, using annual-time-series data, from 1970 to 2003. Appropriate statistical tools are employed to explore the relationship between these variables. It examines stochastic characteristics of each time series by testing their stationarity using Augmented Dickey Fuller (ADF) and Phillip Perron (PP) tests. This is followed by estimating the error correction model of public education expenditure. The effects of stochastic shocks of public education expenditure and defence spending are explored, using vector autoregressive (VAR) model.

Although some people argue that the military may contribute towards the promotion of the modernization of developing societies through the enhancement of the quality and quantity of human capital by, among others, dismantling social rigidities, there is limited conclusive evidence to support this view. In fact, a negative trade-off between defence spending and public education expenditure (used as a proxy for human capital formation) is generally expected.

A regression analysis of the relationship between the military spending and the public education expenditure in Nigeria from 1970 to 2003 is positive and statistically significant in all the techniques employed. It should be pointed out that the statistical analyses conducted in this study are concerned only with reported public expenditures on education. Inasmuch as private education and private expenditures on public education are excluded, the data employed understate the country's commitment to education. With this caveat in mind, the study concludes that it is not unlikely that military activity has served to enhance the productive capability of the Nigerian economy via some modernizing effect. Thus, in the short and long run, the impact of military expenditure on Nigeria's stock of human capital, particularly education, has been positive.

Key Words: Human Capital, Public Education Expenditure, Defence Spending, Error Correction Mechanism, and Vector Autoregressive Model.

Introduction

Economic development theorists generally agree that the quality of human resources has a significant impact on economic development and growth. This body of thinking is of the opinion that the quality and quantity of labour determine the production by virtue of it being a major factor of production. Moreover, improving the quality of the labour force yields implicit, non-economic outputs related to the generation of ideas and decisions which have a significantly positive impact on investment, innovation and other growth opportunities (Roux, 1994).

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Although various factors determine the quality of human capital and, according to Hartshorne (1985) “... there is a problematic relationship between education and economics which the conflicting theories of the economists have done little to illuminate”, there is sufficient evidence to suggest that formal education makes a positive contribution towards economic growth. Consequently, the definition of a nation’s wealth has widened to accommodate not only physical capital but also human capital as an independent factor of production required to achieve high and sustainable economic growth rates. In recognition of this relationship, however, developing nations have, in varying degrees, attempted to stimulate the accumulation of human capital through public education expenditure as well as government spending on health and related social services. The success of government initiatives in this regard can be gauged from the fact that in the late eighties, all developing countries allocated an average of 4.0 per cent of their gross domestic product to public education expenditure. However, although this represents an improved performance on previous years, comparable data show that during the same period, the average defence spending, as a share of GDP, in developing countries amounted to 6.5 per cent (World Bank, 1992).

This is indicative of the apparent conflict within government budgets between education expenditure, on the one hand, and defence spending on the other. However, the crowding-out effect¹ of defence spending on public education expenditure is not that simplistic (Roux, 1994). In practice, there are numerous channels by which defence spending may have an impact on the stock and quality of human capital. Some of these channels may ultimately be of a positive nature. Against this background, this study attempts to examine the interactions between defence spending and public education expenditure in Nigeria, with a view to quantifying the effects for the country. The rest of the paper is structured as follows. Section two discusses the theoretical underpinnings and empirical evidence, while section three explains the data and the methodology of the paper. Empirical results are presented in Section four, while the summary and conclusions are contained in the last section.

Theoretical Considerations and Empirical Evidence

In any country, there can be no meaningful economic growth without adequate human and natural resources. Human capital is so important that in the Khartoum Declaration of 1988, it was asserted that:

...the human dimension is the sine qua non of economic recovery ...no SAP or economic recovery programme should be formulated or can be implemented without having at its heart detailed social and human priorities. There can be no real structural adjustment or economic recovery in the absence of the human imperative (Adedeji, et al., 1990).

The concept of human capital refers to the abilities and skills of human resources of a country, while human capital formation refers to the process of acquiring and increasing the number of persons who have the skills, education and experience that are critical for economic growth and development of a country (Okojie 1995). Human resources are all embracing, that is, it is inclusive of persons who work now, or are likely to be productively employed sooner or later. It is a continuum, a continuing process from childhood to old age, and a must for any society or enterprise that wishes to survive under the complex challenges of a dynamic world.

Yesufu (2000), in agreement with this view, opines that “the essence of human resources development becomes one of ensuring that the workforce is continuously adapted for, and upgraded to meet, the new challenges of its total environment”. This implies that those already on the job require retraining, reorientation or adaptation to meet the new challenges. This special human capacity can be acquired

¹ The proposition is that government spending on defence reduces the volume of resources available for spending in other areas of the economy, including education.

and developed through education, training, health promotion, as well as investment in all social services that influence man's productive capacities (Adamu, 2003)

In human capital development, education is essential. Education is concerned with the cultivation of "the whole person" including intellectual, character and psychomotor development. It is the human resources of any nation, rather than its physical capital and material resources, which ultimately determine the character and pace of its economic and social development. Thus, human resources:

"constitute the ultimate basis for the wealth of nations. Capital and natural resources are passive factors of production; human beings are the active agents who accumulate capital, exploit natural resources, build social, economic and political organization, and carry forward national development. Clearly, a country which is unable to develop the skills and knowledge of its people and utilize them effectively in the national economy will be unable to develop anything else" (Harbison, 1973).

Education occupies an important place in most plans for economic and social development. Whichever way one looks at it, the education sector is important in human development as a supplier of the trained manpower and it is a prerequisite for the accomplishment of other development goals. Also, it is the main sector through whose national identity goals and aspirations are given meaning and reality among the people.

Despite the importance of educational institutions, Nigeria spends an almost insignificant proportion of her financial resources on education. In Nigeria, education expenditure as a proportion of gross domestic product (GDP) averaged 5.64 per cent between 1986 and 1990, compared to 5.84 per cent between 1999 and 2003. This performance fell below those of other developing countries, which in 1960 and 1977 were spending an average of 11.7 and 16.3 per cent of their total expenditure on education respectively. The United Nations recommends that 26 per cent of the total expenditure be devoted to education. Seychelles had committed 10.2 per cent of its gross national product (GNP) to total education in 1985-87 and 8 per cent in 1995-97. Ghana allocates an average of 20 per cent of its total expenditure to education yearly. Between 1986 and 1992, Botswana spent 21 per cent of her expenditure on education; Malaysia, 19 per cent; Kenya, 20 per cent; Uganda, 15 per cent; and Nigeria, 5.23 per cent (Olaniyi and Adam, 2003).

Not only that education expenditure, as a percent of total expenditure, falls in many developing countries, including Nigeria, the budgetary allocations to the formal education system also have the shape of an inverted pyramid in which secondary and tertiary education receive more than four times as much public resources as primary education². In many cases primary schools are starved of financing while universities receive heavy subsidies. The majority of the population, particularly the poor, may lack adequate educational facilities, or may find that the opportunity cost of attending school exceeds short run private benefits, while the children from middle and upper class backgrounds benefit from comparatively generously financed university education³.

Not only is this inversion of the financial pyramid not equitable, it is also not efficient. Particularly in the poorest developing countries, where primary education has been most neglected, the social rate of

2 The inverted pyramid applies not only to public expenditure on formal education but also to health, pensions, public food distribution, transportation (compare air travel with farm-to-market roads), irrigation (compare expenditures on large scale water management projects with small scale irrigation facilities), industrial support, etc. In each case, expenditure per beneficiary increases as one climbs the pyramid while net social returns tend to fall. Thus the point made in the study about the composition of educational expenditure has wide applicability to other sectors.

3 For example in Indonesia in 1978, it was estimated that 83 percent of state subsidies to higher education accrued to the upper income group, 10 percent to the middle income group and only 7 percent to the lower income group. Indonesia is perhaps an extreme case, but a similar pattern is evident in Nigeria, Chile, Colombia and Malaysia.

return on investing in basic education is high⁴. In addition to high returns, investing in primary education has the advantage of bringing government closer to the people it serves while simultaneously giving people greater control over their own lives and a basic institution of the communities in which they live. Primary schools are easier for local communities (villages, small towns, urban neighbourhoods) to control than secondary schools, colleges and universities. There is more opportunity for participatory development, for the active involvement of people in education and hence, there is a greater likelihood that educational programmes will enjoy sustained support from the community.

Despite this importance, it is discovered that educational sector in Nigeria is poorly funded. One may ask: why this poor funding in education? The explanation to this can be attributed, among others, to excessive defence spending. There has not been a clear link between public education expenditure and defence spending. While, Benoit (1973) postulates that technical training is a vital element of military service which augments the skill content of the existing labour force, Ball (1983) questions the value of military-induced training and education in a country where unemployment is so high that the soldier will not be able to find gainful employment at the termination of his military service. Whynes (1979) has suggested that the military has an important role to play in dismantling social rigidities by virtue of the fact that it is a progressive institution. Moreover, military regimes are sometimes perceived to promote the modernization of society which, in turn, dispenses with its feudal and social obligatory system (Pye, 1972) and moves towards a market-oriented, capitalist system which places a much greater premium on enhancing the quantity and quality of human capital in society (Roux, 1994).

Diamond (1990) also argues that defence expenditure, by ensuring the maintenance of security and public order, may be an essential precondition for healthy investment environment. However, Arora and Bayoumi (1994) argue that reduction in world military spending would offer significant long-term benefits for private investment and private consumption, especially for developing countries. Depending on the structure of country's economy and the composition of her military expenditure, a reduction in military spending may have positive welfare effects on the populace through the primary impact of the reductions on national security (Olaniyi and Adam, 2003). In general, therefore, the defence sector may enhance the supply of skilled labour, thereby alleviating an important growth constraint. Conversely, however, it may compete for scarce human resources with the more productive civilian economy, thereby compromising the overall productivity and efficiency of the economy (Roux, 1994).

The bulk of research on the trade-off⁵ between defence and social programmes has emanated from, and been applied to, industrialized nations. From the observation that there has generally been a trade-off of almost equivalent amounts between military expenditure and investment in developed countries, Smith (1980: 31-32) concludes that defence spending does not significantly affect the social wage (including education), the burden of higher defence outlays primarily falling on investment. However, in African countries, most of the researchers come to the general conclusion that military spending substitute for spending on other sectors of the economy. Gyimah-Brempong (1998, 1992), using simultaneous equation models and panel data, found that there is a trade off between military spending and the expenditure on social services, including investment in physical and human capital. Dunne and Mohammed (1995) also found that military spending in African countries substitute for investment in human and physical capital.

4 In Africa, for example, the rates of return on investments in education are estimated to be 26 percent for primary education, 17 percent for secondary education, and 13 percent for higher education. These rates of return include public subsidies in total costs but do not attempt to include positive externalities in the benefits. Thus they understate the true social rates of return.

5 The concept of trade-off is used to describe the way in which one policy area may aim at the expense of others in the allocation of scarce resources. There is a continuum of possible trade-off patterns. At one extreme, increases in defence expenditure may be entirely paid for by decreases in health or education expenditure, producing a negative trade-off effect. A positive trade-off would occur if defence spending increases are matched by increases in education spending.

Griffin and McKinley (1992) are of the opinion that human capital development is a growth and development strategy intended to improve the well being of people in as short a time as possible. They believe that implementation of the strategy will require a change in the composition of government spending and that the percentage of the budget earmarked for activities, which do not contribute to development, should be reduced to a minimum. This includes spending on the military and internal security (which often have little to do with defending the state from external enemies), subsidies for some public enterprises (such as airlines, luxury hotels and breweries which cater primarily to upper income groups), excessively large bureaucracies in the public administration (which sometimes have been used to reduce unemployment among the urban educated youth) and external debt service (Griffin and McKinley, 1992).

The normative and traditional assumption is that governments of developing nations have displayed a greater willingness to reduce the social wage for human capital to accommodate an increase in defence expenditure. This willingness can be attributed to the virtual absence of institutional resistance (e.g. influential trade unions or consumer groups) to decreasing the social wage, together with a reluctance to reduce investment expenditure (Deger, 1986: 115). The implication is that increased defence spending in developing countries may have negative consequences for socio-economic development programmes such as education. This has been supported by economic theory (Fosu, 2001; 1999; 1996; Adebisi, 2003 and Tomori and Adebisi, 2002).

In many developing countries expenditure on the military and internal security represent a massive diversion of public resources to socially wasteful purposes. Considering just military expenditure, and ignoring expenditure on internal security, there appears to be a rough inverse association between the level of human capital development and the percentage of total income absorbed by the military. For example, in 1989 the developing countries classified by United Nations Development Programme (UNDP) as “high human development” allocated 3.1 per cent of their gross domestic product to military expenditure. The “medium human development” countries excluding China allocated 4.5 per cent and the “low human development” countries excluding India allocated 4.8 per cent (Griffin and McKinley, 1992). There is thus, a *prima facie* case for enquiring in every country contemplating adopting a human capital development strategy whether it would be possible to reduce the resources allocated to the army, navy, air force, intelligence services and secret police, paramilitary units, local police, etc., in order to increase outlays on more productive activities, like education.

Military expenditure and debt servicing account for a high proportion of total expenditure in many developing countries and the two items often are closely connected. In fact more than a third of the total external debt of developing countries was incurred to acquire military equipment at the expense of other social services like education. Moreover, research suggests that the availability of external loans actually increases the propensity of governments to spend on the military (Hewett, 1991). It is not uncommon for military spending and payments on the foreign debt to absorb 40-80 per cent of current government revenue. For example, in 1987 these two items accounted for 55 per cent of government revenue in Sri Lanka, 61 per cent in Pakistan, 64 per cent in the Philippines, 65 per cent in Colombia and 85 per cent in Jordan (Deger and Sen, 1990). Between 1960 and 1988 military spending in developing countries increased five-fold in constant U.S. dollars and grew twice as fast as income per head (McNamara, 1991). In the late 1980s the rate of growth of spending on the military declined somewhat, but it could well increase again in the 1990s (Griffin and McKinley, 1992).

Data and Methodology

This section presents the data set and the econometric framework, including vector autoregressive (VAR) Models.

The Data Set and Description

The data set for this paper consists of annual time series spanning 1970 through 2003. The variables under consideration are public education expenditure as a percentage of gross domestic products; military spending as a percentage of gross domestic products; total government expenditure as a percentage of gross domestic products and growth rate of real gross domestic products (i.e. the economic growth rate). The variables are obtained from Central Bank of Nigeria’s Statistical Bulletin and Economic and Financial Review, various years.

Table 1 gives the description of variables used in the estimation.

Table 1: Descriptive Statistics

(1970-2003)

	RGDPG	DEFGDP	EDUGDP	EXPGDP
Mean	3.739717	1.356588	1.265588	9.751471
Median	3.527542	1.170000	1.085000	9.225000
Maximum	23.41000	2.840000	4.640000	14.75000
Minimum	-26.81913	0.470000	0.110000	6.150000
Std. Dev.	8.319436	0.663305	0.970015	2.188416

Note: EDUGDP measures public education expenditure a ratio of gross domestic products; DEFGDP stands for military spending as a percentage of GDP; EXPGDP is total government expenditure as a percentage of GDP; and RGDPG is the growth rate of real gross domestic product.

Sources: Central Bank of Nigeria, *Statistical Bulletin*, various issues.

The growth rate of real gross domestic product (RGDPG) averages 3.74 percent. It ranges from – 26.82 percent to 23.41 percent and with a standard deviation of 8.32. Defence expenditure as a ratio of GDP (DEFGDP), which has a mean of 1.36 percent, varies from a minimum of 0.47 percent to a maximum of 2.84 percent with standard deviation of 0.66 percent. Education expenditure as a ratio of GDP (EDUGDP) averages 1.27 percent and varies from 0.11 percent to 4.64 percent, with a standard deviation of 0.97 percent. Expenditure-GDP ratio (EXPGDP) has a mean of 9.75 percent. It varies from a minimum of 6.15 percent to a maximum of 14.75 percent with a standard deviation of 2.19 percent.

Econometric Framework

This paper uses the forecast error variance decomposition and the impulse responses from estimated vector autoregressive models (VAR) to examine the effects of shocks to public education expenditure. VAR models are the best method for investigating shock transmission among variables because they provide information on impulse responses (Adrangi and Allender (1998). Zellner and Palm (1974), Zellner (1979), and Palm (1983) show that any linear structural model can be written as a VAR model. Therefore, a VAR model serves as a flexible approximation to the reduced form of any wide variety of simultaneous structural models.

Let us consider a bivariate AR (1) model. Let y_t be a measure of public education expenditure and z_t be the defence spending. A VAR system can be written as follows

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = A_0 + A [L] \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

A_0 is a vector of constants, $A (L)$ a 2X2 matrix polynomial in the lag operator L , and u_{it} serially

independent errors for i . Suppose the structural equations can be represented as follows

$$y_t - b_{10} - b_{12}z_t + b_{11}y_{t-1} + b_{13}z_{t-1} + u_{yt} \dots\dots\dots (1)$$

$$z_t - b_{20} - b_{21}y_t + b_{22}y_{t-1} + b_{23}z_{t-1} + u_{zt} \dots\dots\dots (2)$$

which can be rewritten as

$$y_t + b_{10}z_t = b_{10} + b_{11}y_{t-1} + b_{13}z_{t-1} + u_{yt} \dots\dots\dots (3)$$

$$z_t + b_{21}y_t = b_{20}y_t + b_{22}y_{t-1} + b_{23}z_{t-1} + u_{zt} \dots\dots\dots (4)$$

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{13} \\ b_{22} & b_{23} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

let

$$B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$$

$$Z = \begin{bmatrix} y_t \\ z_t \end{bmatrix}$$

$$V_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$$

$$V_1 = \begin{bmatrix} b_{11} & b_{13} \\ b_{22} & b_{23} \end{bmatrix}$$

which allows us to write a more compact form of the structural equation as

$$BZ_t = V_0 + V_1 Z_{t-1} + u_{it}$$

Assuming that B is invertible, we pre-multiply the equation by B^{-1} to obtain

$$Z_t = A_0 + A_1 Z_{t-1} + \epsilon_{it} \dots\dots\dots (5)$$

Where

$$A_0 = B^{-1}V_0$$

$$A_1 = B^{-1}V_1$$

$$\text{and } \epsilon_t = B^{-1}u_{it}$$

Given the a_{ij} is the element of the i^{th} row and j^{th} column, we can now write our VAR in standard form.

$$y_t + a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + \epsilon_{yt} \dots\dots\dots (6)$$

$$y_t + a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + \epsilon_{zt} \dots\dots\dots (7)$$

and the matrix form,

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{yt} \\ \epsilon_{zt} \end{bmatrix} \dots\dots\dots (8)$$

Michael Adebayo Adebisi

Note that the errors are a composite of two errors u_{yt} and u_{zt} since $\varepsilon_t = B^{-1}u_{it}$ i.e.

$$\begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix} = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}^{-1} \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

so that

$$\varepsilon_{yt} = \frac{u_{yt} - b_{12} u_{zt}}{1 - b_{12} b_{21}} \dots\dots\dots (9)$$

$$\varepsilon_{zt} = \frac{u_{zt} - b_{21} u_{yt}}{1 - b_{12} b_{21}} \dots\dots\dots (10)$$

Since the u_{it} s are white noise, so are the ε_t s.

From Equations 9 and 10, we can see that policy errors can be caused by exogenous y and policy disturbances. Let Σ_u be the 2X2 variance-covariance matrix of u_{it} and Σ_ε that of ε_{it} . Then $\Sigma_\varepsilon = B \Sigma_u B^1$. To determine the impact of policy on output, we need to look at the effect of u_{zt} but unless $b_{21} = 0$, ε_{zt} is not equal to u_{zt} and therefore does not provide a measure of the policy shock. If we estimate our VAR in Equations 6 and 7 as it is, B and Σ_ε will not be identified without further restrictions since estimation of the reduced form in Equations 6 and 7 will yield less parameters than the structural form in Equations 1 and 2. One of the most common restrictions is to assume that the structural shocks are uncorrelated so that the off diagonal elements in the covariance matrix are zero (Simatele, 2003; Bernanke and Blinder, 1992).

Two results obtained from VARs that are useful for analyzing transmission mechanisms are impulse response functions and forecast error variance decompositions. The impulse responses tell us how public education expenditure responds to shocks in defence spending and other policy variables, while the variance decompositions show the magnitude of the variations in public education expenditure due to defence spending and other policy variables.

If we assume a stable system (like Simatele, 2003), we can iterate Equation 5 backwards and let n approach infinity and solve to obtain

$$Z_t = \lambda + \sum_{i=0}^{\infty} A_1^i \varepsilon_{t-i}$$

Where the λ s are the means of y_t and z_t and use Equation 8 to get

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \mu_y \\ \mu_z \end{bmatrix} + \frac{1}{1 - b_{12} b_{21}} \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} 1 - b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix} \dots\dots\dots (11)$$

We define the 2X2 matrix as $F(i)$ with elements $F_{jk}(i)$ such that

$$F(i) = \frac{A_1^i}{1 - b_{12} b_{21}} \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$$

and we write in moving average form as

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} u_y \\ u_z \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} F_{11}(i) & F_{12}(i) \\ F_{21}(i) & F_{22}(i) \end{bmatrix} \begin{bmatrix} u_{yt-1} \\ u_{zt-1} \end{bmatrix}$$

or in a more compact form

$$Z_t = \mu + \sum_{i=0}^{\infty} F(i)u_{t-1} \dots\dots\dots 12)$$

$F_{jk}(i)$ are the impulse response functions. As we vary (i), we get a function describing the response of variable j to an impulse in variable k (Simatele, 2003).

To derive the forecast error variance decompositions, we use Equation 12 to make a forecast of z_{t+1} . The one-step-ahead forecast error is Fu_{t+1} and in general the n-period forecast error $Z_{t+n} - E_t Z_{t+n}$ is

$$Z_{t+n} - E_t Z_{t+n} = \sum_{i=0}^{\infty} F(i)u_{t+n-i} \dots\dots\dots (13)$$

and the mean square error (MSE)

$$(Z_{t+n} - E_t Z_{t+n})^2 = \sigma_z^2 \sum_{i=0}^{\infty} F(i)^2 \dots\dots\dots (14)$$

where σ_z^2 is the variance of z_{t+n} .

To show that the decomposition more explicitly, let us narrow down on y_t

$$y_{t+n} - E_t y_{t+n} = \sigma_y^2 \sum_{i=0}^{\infty} F(i)^2 \dots\dots\dots (15)$$

The share of σ_z^2 due to u_{yt} and u_{zt} are

$$\frac{\sigma_y^2 [F_{11}(0)^2 + F_{11}(1)^2 + \dots + F_{11}(N-1)^2]}{\sigma_y(n)^2} \dots\dots\dots (16)$$

$$\frac{\sigma_z^2 [F_{11}(0)^2 + F_{11}(1)^2 + \dots + F_{11}(N-1)^2]}{\sigma_y(n)^2} \dots\dots\dots (17)$$

Since the variance decomposition tells us the share of the total variance attributed to a given structural shocks, for an exogenous sequence y , u_{zt} will not explain any of the forecast error variance of y_t .

In using VAR model, the selection of lag order is very essential. Without a formal method, the selection of lag order in a VAR model will be arbitrary and could lead to specification error (see Fair and Schiller, 1990; Funke, 1990). Several criteria, similar to those used in the distributed lag models, are suggested to determine the model dimension (see Judge, et al., 1985; Lutkepohl, 1985).

Policy and Sensitivity Analyses

Unit Root Tests

In the literature, most time series variables are non-stationary and using non-stationary variables in the model might lead to spurious regressions (Granger 1969). The first or second differenced terms of most variables will usually be stationary (Ramanathan 1992). All the variables are tested at levels for stationarity using the Augmented Dickey-Fuller (ADF) and Phillip-Perron tests. The test reveals that all the variables are stationary at levels except ratio of defence spending to GDP (DEFEXP) and expenditure-GDP ratio (EXPGDP) (using Phillip-Perron test), which are stationary at first difference (see Table 2).

Table 2: Unit Root Test Using Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Tests: 1970- 2003

Variables	ADF Test Level	95% ADF Critical Level	Order of Integration	PP Test at Level	95% PP Critical	Order of
RGDPG	-3.96*	-3.55	I (0)	-4.87*	-3.55	I (0)
EXPGDP	-3.78*	-3.55	I (0)	-3.99*	-3.55	I (0)
EDUGDP	-3.65*	-3.55	I (0)	-3.08	-3.55	I (1)
DEFGDP	-3.09	-3.55	I (1)	-2.82	-3.55	I (1)

Note: Variables are as defined in Table 1

*Significant at 5 per cent level

Co-integration Test and Results

Co-integration tests were conducted by using the reduced rank procedure developed by Johansen (1988) and Johansen and Juselius (1990). This method should produce asymptotically optimal estimates since it incorporates a parametric correction for serial correlation. The nature of the estimator means that the estimates are robust to simultaneity bias, and it is robust to departure from normality (Johansen, 1995). Johansen method detects a number of cointegrating vectors in non-stationary time series. It allows for hypothesis testing regarding the elements of co-integrating vectors and loading matrix. Johansen procedure is used to determine the rank r and to identify a long-run relationship. The number of lags used in the VAR is based on the evidence provided by the Akaike Information Criteria. However, in the case of serial correlation, sufficient numbers of lags are introduced to eliminate the serial correlation of the residuals. The co-integration tests include public education expenditure a ratio of gross domestic products (EDUGDP); military spending as a percentage of gross domestic products (DEFGDP); total public expenditure as a percentage of gross domestic products (EXPGDP) and the growth rate of real gross domestic products (i.e. the economic growth rate) (RGDPG).

Table 3 reports the estimates of Johansen procedure and standard statistics.

Table 3: Johansen Co-Integration Test

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	Hypothesized No. of CE(s)
0.629958	66.38680	47.21	None *
0.416415	34.57433	29.68	At most 1 *
0.339387	17.34025	15.41	At most 2 *
0.119527	4.073470	3.76	At most 3 *

Notes: VAR includes seven lags on each variable and a constant term. The estimation period is 1986:1-2002:4. None of the deterministic variable is restricted to the co-integration space; Likelihood ratio is trace test statistics, adjusted for degrees of freedom. The critical values are taken from Osterwald-Lenum (1992). The * indicates rejection of likelihood ratio tests at 5% significance level. L.R. test indicates 4 co-integrating equation at 5% significance level.

In determining the number of co-integrating vectors, we used the degrees of freedom, adjusted version of trace statistics, given the existence of small samples with too many variables or lags. Johansen

procedure tends to over estimates the number of co-integrating vectors. The test statistics strongly reject the null hypothesis of no co-integration in favour of four co-integration relationships.

Correlation Matrix

Table 4 provides the correlation matrix. According to the Table, positive correlation exists between public education expenditure and defence spending (0.58). This corroborates with the findings by Smith (1980) that defence spending does positively affect the social wage (including education) and that the burden of higher defence outlays primarily fall on investment. The positive effect may be attributable to the possibility of spin-off effect of defence on education as demonstrated by Roux (1994) and Pye (1970). They show that military regimes promote the modernization of society by dispensing with its feudal and social obligatory systems and by moving towards a market-oriented, capitalist system. This places a much greater premium on enhancing the quantity and quality of human capital, particularly education, in a country.

Negative correlation exists between real gross domestic product and public education expenditure (-0.28). The negative correlation may be attributable to high inflation rate in Nigeria, particularly in the early nineties. Total public expenditure and public education expenditure are positively correlated (0.66). Also a positive correlation exists between total public expenditure and defence spending (0.46). This implies that an increase in total public expenditure will increase, not only the share of public education expenditure in the total public expenditure but also, defence spending.

Table 4: Correlation Matrix

(1970-2003)

	RGDPG	EXPGDP	DEFGDP	EDUGDP
RGDPG	1.000000	-0.085713	0.013304	-0.283397
EXPGDP	-0.085713	1.000000	0.454755	0.660860
DEFGDP	0.013304	0.454755	1.000000	0.576060
EDUGDP	-0.283397	0.660860	0.576060	1.000000

Note: Variables are as defined in Table 1

However, correlation should not be seen as causality. The correlation between two totally unrelated series could be strong while causality between the same variables may be non-existent. Therefore, in Table 5, we perform formal tests of causality in addition to reporting simple correlation coefficients between two variables.

Pairwise Granger Causality Test

Pairwise Granger causality test between public education expenditure and defence spending, including total public expenditure and real gross domestic products are examined in Table 5.

The Pairwise Granger causality tests were inconclusive at 5 per cent level of significance. The results alternated between bi-directional, no causality and uni-directional, depending on the lag length allowed. The outcome in respect of one-lag length is presented in Table 5. The Table reveals that growth rate of real gross domestic products Granger causes total expenditure. Moreover, defence spending and public education expenditure are Granger-caused by total public expenditure. It is also observed that public education expenditure Granger-causes defence spending.

Table 5: Pairwise Granger Causality Tests

Sample: 1970 2003

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
EXPGDP does not Granger Cause RGDPG RGDPG does not Granger Cause EXPGDP	33 0.08897	4.13281 0.76755	0.05099
DEFGDP does not Granger Cause RGDPG RGDPG does not Granger Cause DEFGDP	33 2.34195	0.04067 0.13641	0.84154
EDUGDP does not Granger Cause RGDPG RGDPG does not Granger Cause EDUGDP	33 0.00025	0.47763 0.98756	0.49481
DEFGDP does not Granger Cause EXPGDP EXPGDP does not Granger Cause DEFGDP	33 0.50364	6.32539 0.48338	0.01749
EDUGDP does not Granger Cause EXPGDP EXPGDP does not Granger Cause EDUGP	33 1.50620	8.53349 0.22926	0.00656
EDUGDP does not Granger Cause DEFGDP DEFGDP does not Granger Cause EDUGDP	33 9.81548	0.08586 0.00385	0.77153

Note: Variables are as defined in Table 1.

The Trade-off between Education and Defence in Nigeria

The major focus in this section lies in the empirical analysis of the complex interrelationships between defence spending and public education expenditure in Nigeria. From this regression result, defence spending has a positive and significant relationship with public education expenditure. A 100 percent increase in defence spending raises public education expenditure by 53 per cent. Also, there is a positive and significant relationship between total public expenditure and public education expenditure. 100 percent rise in total expenditure will increase education expenditure by 21 percent. However, a negative but significant relationship exists between growth rate of real gross domestic product and public education expenditure. A one percent increase in growth rate of real GDP reduces public education expenditure by 0.03 percent.

Table 6: Long-Run Static Regression of Education Expenditure

(1970-2003)

Dependent Variable: EDUGDP

Method: Least Squares

Sample: 1970 2003

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEFGDP	0.531853	0.191567	2.776326	0.0094
EXPGDP	0.210211	0.058273	3.607348	0.0011
RGDPG	-0.028868	0.013653	-2.114352	0.0429
C	-1.397830	0.524113	-2.667040	0.0122
Adjusted R-squared	0.552392			
Durbin-Watson stat	1.653216			

Note: Variables are as defined in Table 1.

In Table 6, it was found that changes in the education variable were well explained by the combined effect of the independent variables. However, there is statistical evidence supporting a positive relationship between defence spending and public education spending. This means that military expenditure in Nigeria promoted public expenditure on education between 1970 and 2003. The explanation may be attributable to the fact that education and defence programmes may increase in tandem with one another because both are supported by relatively strong interest groups. Hence, demands by well-organised education groups for increased education expenditure are matched by similar demands by powerful military groupings. As a result, both education and defence budgets benefit at the expense of socio-economic activities that are bereft of organisational pressure (Roux, 1994; Verner, 1983: 87-88).

To further verify the trade-off relationship between public education expenditure and defence spending, we estimate the error correction model of public education expenditure.

Error-Correction Model (ECM) of Public Education Expenditure

In order to capture the short-run deviations that might have occurred in estimating the long-run co-integrating equation, a dynamic error-correction model is formulated. The ECM is estimated with respect to the dependent variable, public education expenditure, using ordinary least squares. Given that the primary objective of the study is to investigate the relationship between public education expenditure and defence spending, the aim of this sub-section is to analyze the coefficients of error correction term and defence spending. The coefficient of error correction term depicts the speed of convergence to equilibrium once the equation is shocked. The dynamic error correction formulation is presented as follow:

$$\Delta EDUGP_t = h_0 + h_{1i} \sum_{i=0}^1 \Delta EDUGDP_{t-1} + h_{2i} \sum_{i=0}^1 \Delta DEF GDP_{t-1} + h_{3i} \sum_{i=0}^1 \Delta RGDPG_{t-1} + h_{4i} \sum_{i=0}^1 \Delta EXP GDP_{t-1} + h_5 ECM_{t-1} + ui \dots\dots\dots (18)$$

where ECM is the error correction term (lagged residual of static regression) and ‘D’ stands for first difference. All the variables (first order differenced) in the equation are stationary and therefore OLS method gives consistent estimates (Enders, 1995). The model is estimated by the OLS method.

An important feature to notice is the significance of the equilibrium in the education expenditure equation. The coefficient of the error-correction terms carries the correct sign and it is statistically significant at 1 percent, with the speed of convergence to equilibrium of 89 per cent (see Table 7). In the short run, public education expenditure is adjusted by 89 percent of the past year’s deviation from equilibrium.

The coefficient of defence spending is statistically significant at 5 per cent level of significance. This implies that a 100 per cent increase in defence expenditure will significantly raise public education expenditure by 63 per cent. This confirms our findings in Table 6.

On this basis, we reach the conclusion that the relationship between defence spending and public education expenditure has been largely positive. There is, therefore, sufficient evidence to support the possibility that the military has improved the productivity and efficiency of the economy via a benign positive spin-off effect on education and the enhancement of human capital.

Forecast Error Variance Decomposition

An examination of the short-run dynamic properties of public education expenditure is further investigated by estimating forecast error variance decomposition and generalized impulse response analysis. Forecast error variance decomposition (FEVD), provides complementary information on the dynamic behaviour of the variables in the system. It is possible to decompose the forecast variance into

Table 7: Parsimonious Error Correction Model

Dependent Variable: D(EDUGP,1)

Method: Least Squares

Sample(adjusted): 1973 2003

Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DEFKDP(-2),1)	0.634857	0.284478	2.231654	0.0345
D(EXPKDP,1)	0.251285	0.038663	6.499308	0.0000
D(EXPKDP(-2),1)	-0.133716	0.034819	-3.840355	0.0007
ECM (-1)	-0.886610	0.148876	-5.955370	0.0000
C	0.042369	0.089399	0.473934	0.6395
Adjusted R-squared	0.707768			
Durbin-Watson stat	1.832882			

Note: Variables are as defined in Table 1.

the contributions by each of the different shocks. When calculated by the structural shocks, as in the present case, the FEVD provides information on the importance of various structural shocks explaining the forecast error variability of public education expenditure and its determinants.

Table 8 presents the FEVD of the four endogenous variables. By definition, the variance decomposition shows the proportion of forecast error variance for each variable that is attributable to its own innovation and to innovation in the other endogenous variables. "Own shocks" variation ranged from 46.1 per cent to 100 percent over the ten-year horizon (Table 8.1). The innovations of defence spending, which accounts for the forecast error variance of public education expenditure ranged from 0 to 44 percent. The persistence of past public education expenditure shocks after ten quarter of the shocks explains 46.1 percent of the variation in current public education expenditure, while defence spending accounts for about 44 percent.

Table 8: Variance Decomposition

Table 8.1: Variance Decomposition of Education Expenditure (EDUGDP)

Period	S.E.	EDUGDP	RGDPG	EXPKDP	DEFKDP
1	0.561225	100.0000	0.000000	0.000000	0.000000
2	0.648502	79.33424	2.116297	0.468666	18.08080
3	0.778073	57.72995	6.491726	0.922673	34.85565
4	0.839677	52.85165	5.608569	1.223368	40.31641
5	0.874803	49.60018	6.827743	1.152836	42.41924
6	0.892512	47.69083	8.135805	1.139748	43.03361
7	0.902743	46.75555	8.433982	1.159850	43.65062
8	0.909426	46.38813	8.460941	1.147431	44.00349
9	0.913124	46.22089	8.571348	1.140216	44.06754
10	0.914808	46.10178	8.719848	1.136086	44.04229

Note: Variables are as defined in Table 1.

“Own shocks” constitute the predominant source of variation in defence spending forecast errors (see Table 8.2). The variation ranged from 86.9 per cent to 99.1 percent over the ten-year horizon. The salient feature of the variance decomposition results is that the predominant sources of public education expenditure fluctuations are due largely to own shocks and defence spending shocks. In sum, the forecast error variance decomposition shows that the innovations of defence spending can be a better predictor of public education expenditure in Nigeria.

Table 8.2: Variance Decomposition of Defence Spending (DEFGDP)

Period	S.E.	EDUGP	RGDPG	EXPGDP	DEFGDP
1	0.312796	0.128403	0.074479	0.699849	99.09727
2	0.422424	0.532963	1.473181	0.385729	97.60813
3	0.509044	1.406233	2.134850	0.432678	96.02624
4	0.569950	3.629317	2.424302	0.417417	93.52896
5	0.606467	5.118823	3.652600	0.374672	90.85391
6	0.626672	5.611176	5.075423	0.351483	88.96192
7	0.636684	5.725283	6.020807	0.350132	87.90378
8	0.641673	5.834158	6.426890	0.353560	87.38539
9	0.644121	5.938035	6.605465	0.352457	87.10404
10	0.645244	5.991864	6.718353	0.351242	86.93854

Note: Variables are as defined in Table 1.

Impulse Response Functions

The impulse response functions are reported in Table 9 and Figures 1 and 2. Impulse response functions are devices to display the dynamics of the variables tracing out the reaction of each variable to a particular shock at time *t*. Tables 9.1 and 9.2 and Figures 1 and 2 show the results of the impulse response analyses derived from the estimated VAR models.

According to Table 9.1 and Figure 1, past public education expenditure shocks has a positive but declining relationship with current public education expenditure in the first two years and the relationship thereafter turns negative. However, a positive defence spending shocks increase public education expenditure significantly in the first two-year periods but decline thereafter. These results of the impulse responses of defence spending shocks are consistent with other findings (Verner, 1983; Hayes, 1976).

The impulse responses show that increase in defence spending will increase public expenditure available for education in the short run. Roux (1994) shows that education and defence programmes may increase in tandem with one another because both are supported by relatively strong interest groups. Hence, demands by well-organised education groups for increased education spending are matched by similar demands by powerful military groupings. As a result, both education and defence budgets benefit at the expense of socio-economic activities that are free from organizational pressure (Verner, 1983: 87-88). Also, the military can be an effective instrument in mobilizing human resources by promoting a disciplined work ethic and fostering basic work skills. Benoit (1973) has also postulated that technical training is a vital element of military service and thus, augments the skill content of the existing labour force.

Table 9: Impulse Response Functions

Table 9.1: Response of EDUGDP to One S.D. Innovations

Period	EDUGDP	RGDPG	EXPGDP	DEFGDP
1	0.561225 (0.07015)	0.000000 (0.00000)	0.000000 (0.00000)	0.000000 (0.00000)
2	0.136643 (0.10484)	-0.094341 (0.10370)	-0.044396 (0.10448)	0.275753 (0.10711)
3	-0.125902 (0.11776)	-0.174358 (0.11319)	-0.060124 (0.12318)	0.367390 (0.09733)
4	-0.152115 (0.11141)	0.015585 (0.09909)	0.055133 (0.10887)	0.270626 (0.10762)
5	-0.083342 (0.09986)	0.112729 (0.09405)	0.014035 (0.10093)	0.200928 (0.10498)
6	-0.017733 (0.08219)	0.112057 (0.07895)	-0.016018 (0.07222)	0.134798 (0.09950)
7	-0.033717 (0.06659)	0.062643 (0.06563)	-0.019317 (0.05017)	0.113718 (0.09329)
8	-0.051226 (0.04885)	0.035277 (0.05280)	-0.006146 (0.03661)	0.090583 (0.08808)
9	-0.041611 (0.03845)	0.038610 (0.04475)	0.004143 (0.02756)	0.059155 (0.08172)
10	-0.020653 (0.03200)	0.038816 (0.03789)	0.000739 (0.02325)	0.033849 (0.07439)

Note: Variables are as defined in Table 1.

Response of EDUGDP to One S.D. Innovations

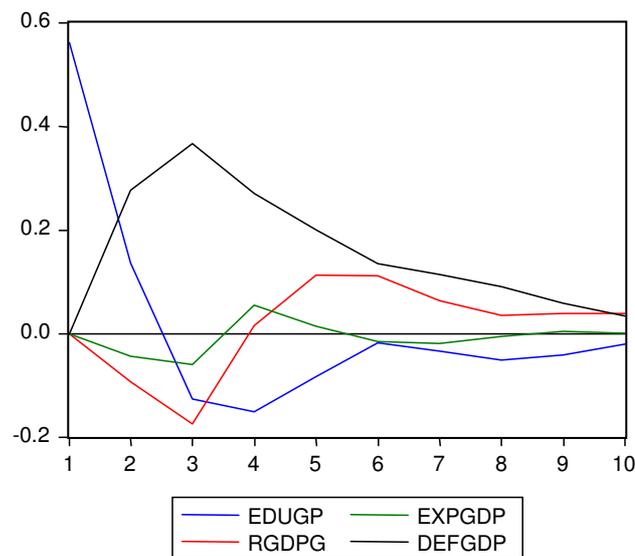


Figure 1: Generalized Impulse Response Education Expenditure to one S.E. Shock in its Explanatory Variables. The Size is 5%

Table 9.2: Response of DEFGDP to One S.D. Innovations

Period	EDUGDP	RGDPG	EXPGDP	DEFGDP
1	-0.011209 (0.05528)	-0.008536 (0.05525)	0.026168 (0.05514)	0.311381 (0.03892)
2	0.028730 (0.07061)	0.050556 (0.07066)	0.001887 (0.07111)	0.277877 (0.06634)
3	-0.051893 (0.07944)	0.053881 (0.07644)	-0.020806 (0.08380)	0.273231 (0.07220)
4	-0.090253 (0.07341)	0.048407 (0.07571)	-0.015322 (0.07828)	0.234506 (0.08112)
5	-0.083890 (0.06699)	0.074560 (0.06968)	0.004701 (0.06283)	0.174184 (0.08642)
6	-0.056648 (0.05487)	0.080609 (0.05945)	-0.001512 (0.05061)	0.123315 (0.09000)
7	-0.034239 (0.04354)	0.066890 (0.04974)	-0.006244 (0.03835)	0.083448 (0.09092)
8	-0.028521 (0.03591)	0.045343 (0.04195)	-0.006037 (0.02865)	0.058924 (0.08760)
9	-0.024791 (0.02995)	0.030711 (0.03580)	-0.002559 (0.02011)	0.039786 (0.08061)
10	-0.017610 (0.02574)	0.023784 (0.03112)	-0.000220 (0.01362)	0.023924 (0.07152)

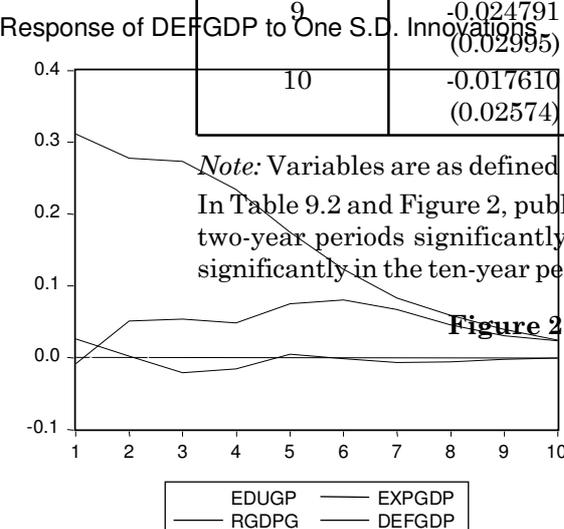


Figure 2: Generalized Impulse Response Defence Spending to one S.E. Shock in its Explanatory Variables. The Size is 5%

Summary and Conclusion

In this study, we set out to empirically investigate the empirical relationship between public education expenditure and defence spending in Nigeria, using annual time series data from 1970 to 2003. Some statistical tools are employed to explore the relationship between these variables. The study examines stochastic characteristics of each time series by testing their stationarity using Augmented Dickey Fuller (ADF) and Phillip Perron (PP) tests. Then, the relationship between public education expenditure and defence spending is dynamically examined using error correction mechanism and the effects of stochastic shocks of each of the endogenous variables are explored, using Vector Autoregressive (VAR) model.

The salient feature of the variance decomposition results is that the predominant sources of public education expenditure fluctuations are due largely to own shocks and to defence spending shocks.

Although it is contended by some that the military may contribute towards the promotion of the modernisation of developing societies through the enhancement of the quality and quantity of human capital by, *inter alia*, dismantling social rigidities, there is limited conclusive evidence to support this view. In fact, a negative trade-off between defence spending and public education expenditure (used as a proxy for human capital formation) is generally expected. A regression analysis of the relationship between military spending and public education spending in Nigeria between 1970 and 2003 is essentially positive and statistically significant in all the statistical techniques employed.

It should be pointed out that the statistical analyses conducted above are concerned only with reported public expenditures on education. Inasmuch as private education and private expenditures on public education are excluded, the data employed understate the country's commitment to education. With these caveats in mind the study concludes that it is not unlikely that military activity has served to enhance the productive capability of the Nigerian economy via some modernizing effect. Thus, in the short and long run, the impact of military expenditure on Nigeria's stock of human capital, particularly education, is positive.

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Michael Adebayo Adebisi

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